an irregular system of moving molecules (or a "disturbed gas") is unaltered in form by collisions between the molecules. In the second application the functions are used to find the mutual potential energy of two layers of gravitating matter on two spheres, the density at any point on each sphere being expressed in terms of spherical harmonics referred to fixed coordinates upon it, and the spheres having any position with reference to the line joining their centres. The case of two ellipsoids not differing much from spheres is also worked out numerically, and the stable positions discussed. A stable orbit is possible with the major axes of the ellipsoids constantly in a straight line. If one ellipsoid is fixed and the other projected so as to describe a nearly circular orbit about it, with its major axis initially pointing to the centre of the other, the orbit will be possible if in a plane perpendicular to the least axis of the greater, but the deviation of the major axis of the second from the line of centres will contain a term which to the first approximation is secular, and may ultimately cause this axis to deviate from its initial position. There are three stable positions for the second ellipsoid if the first ellipsoid is fixed and the centre of the other fixed. These positions will in general be with the major axis of the second pointing towards the centre of the first, and in a line with the major, mean, and least axes of the first, but if c, the distance between the centres, is so small that

$$5\left(\frac{2}{a_1^2}-\frac{1}{a_1'^2}-\frac{1}{a_1''^2}\right)c^2 < \left(\frac{12}{a_1^2}-\frac{7}{a_1''^2}-\frac{5}{a_1'^2}\right)a_1^2, \text{ or than } \left(\frac{12}{a_1'^2}-\frac{7}{a_1''^2}-\frac{5}{a_1^2}\right)a_1^2,$$

where $a_1a_1'a_1''$ are the least, mean, and greatest axes of the first sphere, the stable positions will be different. Thus the stable positions will always be with major axis of the second in the line of centres if c^2/a_1^2 is greater than 7/5.

The "functions of the second kind," which are the two remaining solutions of the differential equation of the fourth order satisfied by u_{mr} v_{mr}, are also briefly investigated.

IV. "On the Measurement of the Magnetic Properties of Iron." By THOMAS GRAY, B.Sc., F.R.S.E., Professor of Dynamic Engineering, The Rose Polytechnic Institute, Terre Haute, Indiana. Communicated by Lord KELVIN, P.R.S. Received April 6, 1894.

(Abstract.)

This paper gives the results of a continuation of the investigation which formed the subject of a paper communicated to the Royal Society in 1892, and published in the 'Philosophical Transactions,'

vol. 184, A, pp. 531—542. The results now given have been to a large extent obtained by the same method, namely, from the curves giving the relation of the current flowing in the circuit to the time measured from the application or the reversal of the impressed E.M.F. on the circuit. In this case, however, the personal element has been eliminated from the curves by the application of the autographic recorder referred to as under construction in the previous paper. This apparatus, which is a modification of the "Thomson siphon-recorder," has been found to work satisfactorily, and has considerably increased the ease and the accuracy with which the curves can be produced. A description of the apparatus and specimens of the curves drawn by it are included in the paper. There is also included in this paper a description of the apparatus and method of experiment in the application of a wattmeter to the determination of the energy dissipated by transformers under E.M.F.'s of different frequency of alternation. The accuracy of the measurements so made were checked by comparison with the results of measurements made by Joubert's instantaneous contact method. The apparatus and method of experiment adopted for the application of this method were to some extent different from those commonly employed, and they are therefore described.

The results of some further experiments on the large electromagnet used in the previous experiments, and described in the paper above referred to, are given, but a large part of the results quoted in this paper refer to closed circuit transformers of the types manufactured by the Westinghouse and the General Electric Companies. The experiments have been chiefly directed to the following points:—

1. *A Comparison of the Total Energy required to produce Different Magnetic Inductions, and the Corresponding Dissipation of Energy.*—In connection with this, the effect of air gap in the magnetic circuit has been investigated somewhat more fully. It is shown that, by introducing a moderate air gap, the energy dissipated for a given induction through the coils may be reduced one-third.

2. *The Law of Variation of Hysteresis with Variation of Induction.*—The experiments indicate that, although for any special case the energy dissipated can be approximately expressed by an equation of the form $E = AB^{\alpha}$, that both A and α are different for different kinds of iron. It seems probable, also, from the results obtained, that α is not absolutely constant for any one iron, but that it increases with increase of B.

3. *The Effect of Increased Frequency of Cyclic Variation of Magnetism on the Dissipation of Energy.*—In this investigation a transformer, the iron case of which was made up of very thin sheets, was used. The thickness of the sheets was about 16-100ths of a millimetre, and the sheets were insulated from each other by means of thin

paper. The full load capacity of the transformer was about 6,000 watts. The range of frequency (including the autographic recorder, the wattmeter and the Joubert's instantaneous contact method experiments) was about from 3 per minute to 8,000 per minute. The results indicated that, throughout this range, there is no variation in the dissipation of energy per cycle when the inductions are equal.

Data deduced from these experiments as to the magnetic qualities of the iron used in the different transformers are given in the paper.

V. "On the Influence of certain Natural Agents on the Virulence of the Tubercle-Bacillus." By ARTHUR RANSOME, M.D., F.R.S., and SHERIDAN DELÉPINE. Received May 1, 1894.

Three years ago Dr. Ransome communicated to the Society the results of some experiments, carried out in concert with Professor Dreschfeld, of Owens College, "On certain conditions that modify the virulence of the bacillus of tubercle."

The tendency of these researches was to prove "that fresh air and light, and a dry and sandy sub-soil, have a distinct influence in arresting the virulence of the tubercle-bacillus; that darkness somewhat interferes with this disinfectant action; but that mere exposure to light, in otherwise bad sanitary conditions, does not destroy the virus."

The following table gives the results of similar experiments by ourselves.

Table I.

Experiment No.		
3.	1.	Rabbit inoculated in peritoneum with fresh sputum. Killed 55 days after. Showed well-marked tuberculosis.
7.	2.	Rabbit. Sputum exposed to light and air 45 days in June and July. Showed no tuberculosis after 86 days.
8.	3.	Rabbit. Sputum exposed in air-shaft in dusk at the same time. Showed slight tuberculosis after 86 days.
11.	4.	Guinea-pig. The same sputum exposed at the same time, in air and light, inoculated under the skin. Showed no distinct tubercle in 80 days.
12.	5.	Guinea-pig. Same methods, only in dusk. Showed advanced tuberculosis in 80 days.
58.	6.	Guinea-pig. Another sputum exposed in April for 16 days to little or no air, in darkness. Gave well-marked tubercle after 42 days.
59.	7.	Guinea-pig. Ditto, ditto.